SOLAR MULTIFUNCTIONAL DRYER FOR DRYING AGRICULTURAL PRODUCTS

Pulat Fayziev*; Khametov Zamir; Abdumalik Abduraxmonov***; Obidov Nuriddin******

*Associate Professor,
Doctor of Technical Sciences,
Fergana Polytechnic Institute, Fergana, Republic of UZBEKISTAN
Email id: p.fayziyev@ferpi.uz

** PhD, Head,
Department of Land Transport Systems and their Operation,
Fergana Polytechnic Institute, Fergana, Republic of UZBEKISTAN
Email id: z.xametov@ferpi.uz

***Associate Professor,
Doctor of Technical Sciences,
Fergana Polytechnic Institute, Fergana, Republic of UZBEKISTAN
Email id: a.abdurahmonov@ferpi.uz

****Assistant,
Department of Land Transport Systems and their Exploitation,
Fergana Polytechnic Institute, Fergana, Republic of UZBEKISTAN
Email id: n.obidov@ferpi.uz

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ABSTRACT

This paper describes a new design of a solar dryer for agricultural products. It is characterized by simplicity of design, reliability in operation, autonomy, and increased resistance to weather changes. The results of field tests of fruits and vegetables are presented. Dried fruits are of high quality and light in colour. The solar installation developed by us is recommended for individual and farm farms.

KEYWORDS: *Innovative Dryer, Grain Vegetables, Fruits, Solar Energy, Food And Medicinal Herbs, Metal Sheet, Foam Plastic, Plastic Film, Absorber, Air.*

INTRODUCTION

The use of solar energy in agriculture is an urgent problem. The main directions are the use of solar energy heat in greenhouses, greenhouses, greenhouses, and drying devices: drying fruits, medicinal and food herbs, hay, vegetables, grains, grapes, lumber and wood for heating premises where livestock, pigs, poultry houses, warehouses are fattened, for heating water for household purposes.

Currently, solar dryers are widely used [1-7], since the production of a dried product, compared to canned fruits and vegetables, requires relatively small capital investments. Drying plants are

conditionally divided into two groups: fuel and solar. The latter has the advantage of saving fuel and energy resources, environmentally friendly production, and favorable natural and climatic conditions under which the season of ripening and processing of agricultural products occur at the same time [7-12]. In the world, solar installations of various designs are used, made by home-made people and produced by the industry, for example, SD-100 or SD-10, they are bulky, expensive, it takes a lot of time to manufacture them, it is unlikely that a simple farmer will buy this installation.

Solar tunnel dryers of the Hohenheim type, developed jointly by the Institute for Tropical and Subtropical Agricultural Engineering of the University of Hohenheim and Innotech, are used in more than 110 countries [13-19].

The Hohenheim tunnel dryer is not without drawbacks. The working surface of 36 m^2 for agricultural products has a film coating located on a metal mesh, therefore. Cereals cannot be dried, as the sharp edges and tips of the cereal shell will damage the film. Only large vegetables and fruits can be dried [20-23]. Strong winds, dry climate and sun are frequent in Uzbekistan, which negatively affects the quality of the film. The film dries up and breaks;

The tunnel dryer is an economically very expensive construction, costing many thousands of US dollars. Photocells cannot directly serve as a source for fans, an inverter converter is needed, which is not mentioned. Due to the large dimensions and cost, the dryer is not rational to use on individual farms. The innovative multifunctional modular solar dryer for vegetables and fruits developed by us for individual farms, fig. 1, is designed for drying all types of agricultural products using the thermal energy of the sun. Simple in design, accessible to every farmer, made from local materials, and has high reliability, this was shown by three-year full-scale tests in the Ferghana Valley (Table 1).

TABLE 1. RESULTS OF FIELD TESTS OF THE SOLAR DRYER IN 2020-2021 (SUMMER)

№	*Fruits and vegetables*	*Drying time. days*		*Dry product yield from 10 kg*
		In a solar dryer	**In a solar dryer**	
1.	**Tomatoes (halves)**	**3-4**	**7-9**	**1**
2.	**Apples (sliced 2 mm thick)**	**1-1.5**	**3-5**	**1.5**
3.	**apricots**	**4-6**	**7-10**	**3**
4	**peaches (halves)**	**4-5**	**6-10**	**3-3.5**
5.	**Dried apricots**	**2-3**	**4-5**	**2,5**
6.	**figs**	**4-6**	**8-10**	**2**
7.	**plums**	**6-8**	**12-14**	**2-2.5**
8	**Plums (halves)**	**3-4**	**6-9**	**2.5**
9.	**cherry**	**3-4**	**5-6**	**2,5**
10.	**Sweet cherry**	**3-5**	**8-10**	**2,7**
11.	**eggplant**	**1-1.5**	**4-5**	**0,7-0,8**
12.	**(straw)**	**1,5-2**	**4-5**	**1,2-1,3**
13.	**bell pepper**	**2-3**	**4.5-6**	**1,3**
14.	**(straw)**	**2-3**	**5-6**	**1,2**
15.	**Carrot**	**-2,5-3**	**5-7**	**0,9**

It is used in individual farms and directly in the gardens at the collection site, which allows you to prevent losses. Solar modular dryer, the area of which can be increased tens and hundreds of times by order. Oriented to the south. The cost of our solar dryer is an order of magnitude cheaper than the HohenHeim dryer.

It is made in the form of a horizontal table with an additional absorber on the south side. The metal sheet covering the horizontal surface of the table, part of which is bent at an angle and serves as an absorber, is painted with matte black paint. A thermal insulation pad (foam 1 cm thick) is laid under the sheet. The area of the foam and the table are the same. The goal is to reduce heat loss from the back of the table. A wooden board 80 cm long, 15 cm wide and 1 cm thick is fixed on one side of the table, on which a polyethene film 1 meter wide is fixed with a thin rail, when drying products, the film is stretched along the table, protecting agricultural products from dust, rain and insects.

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Picture 1 Advantage of the multifunctional solar dryer for drying cereals, vegetables, fruits, medicinal and food herbs

On the other opposite side of the film, we fix a bar that stretches the film over the fruit along the entire length of the dryer table. When the dryer is not working, the film is rolled up and placed in holders. This allows you to save the film during a strong hurricane wind, which often happens in Uzbekistan. Dried vegetables and fruits are of high quality, as the process takes a short time, fruits and vegetables also differ in colour, they are light. From two sides of the table, air passes over the fruit. Creating a draft - natural ventilation. The horizontal table allows you to dry any grain crops, and cut vegetables of all kinds. Fruits, as well as medicinal and food herbs. The working surface of the table is 120 cm long, 80 cm wide and 40 cm high. The capacity of such a dryer is 10-15 kg of products. This makes it possible to dry dried fruits and vegetables during the summer season for the whole winter for a large Uzbek family. The solar dryer has been tested for three years in the author's garden. Polyethene film is sold in all hardware stores and can be easily replaced if necessary.

The structure of the innovative solar modular dryer is durable, compact, transportable, self-contained, and wind-resistant, takes up little space, and is indispensable in remote orchards where fruit grows. The tests were carried out on one modular section. By the order of the

consumer, any number of modules can be made. The module withstood the hurricane wind that swept over the city of Fergana several times in 2018-2021.

1. Reliability, strength, mobility, modularity, autonomy, transportability, durability, wind resistance, protection from rain, hail, storms, and snow;

2. Convenience of safe operation, unlike other similar designs. Compact collector and dryer footprint in one unit;

3. Serviceable by teenagers, school children and the elderly, the extraordinary simplicity and low cost of manufacture makes it competitive with the most famous dryers in the world;

4. High-quality dried products, which are especially suitable for diabetics.

5. Eco-friendly;

6. Economy of standard fuel, reduction of CO_2 emissions, absolute environmental friendliness of the process. The service life of tens of years, as it has no moving working units.

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